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# THE WOOLLEY TESTS APPLIED TO A PREVOCATIONAL CLASS OF BOYS

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## INTRODUCTION

The class referred to in this paper was composed of retarded boys from the public schools of Chicago, who were brought together under the management of the School of Education of the University of Chicago, partly because there was no other school to which they could go and partly to serve as material for investigation in prevocational education. The ages of the boys ranged from fourteen to seventeen years. None of them had completed the eighth grade. The curriculum which was planned for the boys was as follows: in the morning, from nine until twelve o'clock, they worked in the machine shop; in the afternoon, they were engaged in the regular classroom work—arithmetic, history, English, general science, and mechanical drawing.

For the purpose of understanding the boys better, each was given a careful examination in the Psychopathic Laboratory, under the direction of Dr. H. C. Stevens. The Woolley tests were used as a part of this examination, being given by the writer and Mr. E. B. Thomas. This article is a report of the results of these tests.

Prevocational education is described by Professor F. N. Leavitt as having a double purpose: (1) "to improve the courses of study in the elementary school, especially for those children who have not worked successfully under the prevailing methods found therein"; and (2) "to save for this education [in the higher schools] a much larger proportion of the school population, while at the same time giving information about, and practice in, some industrial work."<sup>1</sup> Prevocational education attempts to meet the pupil's needs by differentiating the courses in the upper grades, by reorganizing

<sup>1</sup> *Examples of Industrial Education*, p. 95.

the subject-matter, and by reconstructing the methods of teaching. But we need to have the problem defined still more. We need to know whether the retarded pupils are of normal intelligence and have not gotten along well because of poorly adapted school programs, or whether they are below the normal and have not been able to get along well with the regular work. The Woolley tests help to determine the capacities of such boys, thus making the problem of prevocational education more definite.

The Woolley tests consist of the following:

*Physical tests.*—

Height, after deducting for the heel.

Weight with coat off.

Vital capacity in cubic centimeters.

Grip for each hand taken with the Smedley dynamometer.

Steadiness for each hand.

Tapping. The final record consists of the number of taps for the first half-minute, and for the full minute, and for the fatigue of each hand. The index of fatigue is the difference in the number of taps in the first and third quarter-minutes, divided by the number of taps in the first quarter-minute.

Card sorting. The index is found by dividing the time by the accuracy.

*Mental tests.*—

Cancellation. A sheet of lower-case letters is presented, and the subject is asked to cross out all the *a*'s as quickly as possible. The index is found by dividing the time by the accuracy.

Immediate memory. Seven, eight, and nine place numbers are presented on separate cards and read aloud by the subject and examiner and then the numbers are written down from memory immediately.

Substitution. A card having nine geometric figures, each with a number, is placed in a convenient position. The subject is given pages of fifty geometric figures, like those on the card, and asked to place in these figures numbers which correspond to those on the card. For fourteen- and fifteen-year-old children, three practice pages and one memory page are given; for sixteen-year-old children, only two practice pages are given.

Completion of sentences. The beginnings of sentences were given to the subject to complete. A record was kept of the association time required for each sentence, of the number of sentences completed correctly, of the number of ideas used, and of the index of ideas, found by dividing the time by the number of ideas.

Opposites. Two lists of twenty words each were used—an easier list for the fourteen-year-old subjects than for the fifteen-year-old subjects.

TABLE I  
 PHYSICAL TESTS: Percentile Ranks for Subjects, According to the Norms for Working Children as Worked Out  
 by Woolley and Fischer

SUBJECT	VITAL CAPACITY	GRIP		STEADINESS		TAPS IN 30"		TAPS IN 1'		TAPPING INDEX		CARD SORTING	AVERAGE (PERCENTILE)	RANK
		Right	Left	Right	Left	Right	Left	Right	Left	Right	Left			
C. M.....	96	96	100	100	75	85	90	98	89	55	97.8	55	97.8	1
A. T.....	98	(a)*	(a)*	70	100	100	100	100	100	35	86.8	35	86.8	2
F. S.....	95	55	85	80	83	100	100	85	35	50	79.5	50	79.5	3
R. E.....	83	55	55	60	40	100	100	60	100	74	72.7	74	72.7	4
J. D.....	(a)*	90	95	94	95	30	95	45	95	60	71.2	10	71.2	5
R. W.....	55	75	90	80	85	85	55	98	80	15	66.1	10	66.1	6
R. T.....	100	70	75	80	85	20	20	35	40	85	65.9	80	65.9	7
R. B.....	100	40	40	100	95	30	30	45	50	45	59.2	95	59.2	8
J. MC.....	(a)*	80	90	78	36	3	60	10	70	7	53.3	75	53.3	9
H. R.....	50	30	30	100	95	50	20	70	30	95	51.7	1	51.7	10
F. R.....	(a)*	25	30	90	90	10	70	20	90	5	51.4	45	51.4	11
G. D.....	20	15	15	80	90	25	30	40	50	80	47.9	40	47.9	12
S. M.....	35	30	15	90	85	10	15	20	25	100	45.4	20	45.4	13
E. R.....	58	20	5	97	97	40	30	60	30	45	41.4	5	41.4	14
T. L.....	50	20	10	96	70	30	30	45	45	20	40.9	5	40.9	15
D. S.....	(a)*	(a)*	(a)*	1	1	5	1	15	1	60	20	1	20	16
Average.....	70	50	52.5	80.9	83.8	41.1	47.3	56.1	58.4	64.6	59.2	43.7	59.2	.....

\* (a) Data is missing. The averages have been based upon the number of cases and tests.

TABLE II

MENTAL TESTS: Percentile Ranks for Subjects, According to the Norms for Working Children as Worked out by Woolley and Fischer

SUBJECT	CANCELLATION		MEMORY			SUBSTITUTION				OPPO- SITES AC- CURITY	SENTENCES				AVERAGE (PERCENT- TILE)	RANK
	Index	Ac- curacy	7 Pl.	8 Pl.	9 Pl.	I	II	III	IV		Begun in 2"	Ideas	Index	No. Correct		
F. S.....	70	90	100	100	90	20	75	(a)*	100	(a)*	30	100	65	60	75	1
R. T.....	15	50	98	98	100	65	60	(a)*	86	(a)*	80	100	100	37	74.1	2
E. R.....	60	80	98	7	45	85	34	65	54	100	90	95	100	60	69.5	3
J. D.....	5	40	15	25	35	80	95	95	90	100	25	95	95	80	62.5	4
G. D.....	20	60	40	55	30	80	90	90	80	45	40	75	80	30	58.2	5
R. E.....	15	15	45	55	50	65	95	95	90	95	10	70	25	30	53.9	6
R. B.....	55	70	60	5	55	5	5	5	5	80	80	90	85	80	48.6	7
R. W.....	20	100	30	80	60	30	15	(a)*	20	(a)*	5	100	70	40	47.5	8
C. M.....	5	98	98	20	80	45	40	10	15	15	35	95	80	20	46.9	9
H. R.....	20	50	5	48	35	30	95	70	65	98	1	75	20	20	45.1	10
F. R.....	50	60	10	30	70	20	45	75	84	2	25	75	23	30	42.8	11
T. L.....	45	77	15	25	15	15	70	90	85	10	1	70	30	40	42	12
J. Mc.....	85	90	1	20	1	45	70	(a)*	80	(a)*	10	55	10	20	40.4	13
A. T.....	65	20	5	15	40	1	55	(a)*	45	(a)*	20	65	75	60	38.8	14
S. M.....	5	80	20	50	45	50	70	70	1	20	1	90	50	30	33.5	15
D. S.....	30	55	1	1	1	5	5	(a)*	40	(a)*	10	25	1	2	14.3	16
Average.....	35.3	64.7	39.9	39.5	46.9	40	57.4	66.5	58.7	56.5	28.8	79.7	56.8	39.9	47.4	.....

\* (a) These subjects were sixteen years old. For this age the opposites test is omitted and there are but two practice series in the substitution test.

In giving the tests, the methods given by Dr. Woolley and Mrs. Fischer in *Mental and Physical Measurements of Working Children* (Psychological Monograph, No. 77), were followed as accurately as possible. Preliminary practice was obtained by testing a number of university students.

#### TABULATION OF RESULTS

Table I shows the percentile ranking for each subject in each physical test, according to the norms for working children in Cincinnati. These are presented instead of the scores for each test so that individuals of different ages can be directly compared with one another. A rank of 60 per cent in the table means that there are 40 per cent who did better and 60 per cent who did worse than the individual in question.<sup>2</sup>

In the same way, Table II shows the percentile ranking for each subject in each mental test.

Since only part of the norms for school children were available, a table based on these norms had to be omitted, but enough was gone over to yield some definite results, which will be mentioned later.

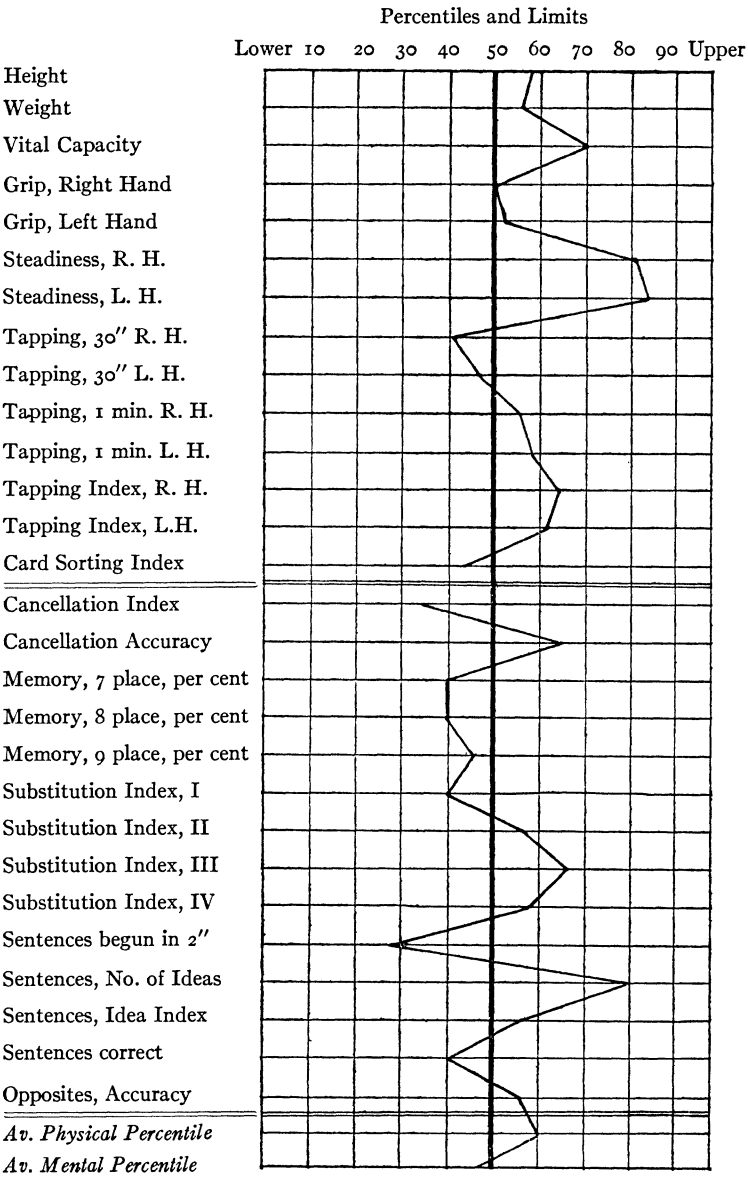
Psychograph I shows the percentile ranking of the group in an average of each test. It will be noticed that the group ranks very high in steadiness, and that, excepting the scores for the number of taps in 30 seconds and the card sorting, the physical standing of the group is as high or higher than the average for working children. Taking the average of all the physical tests, we find that the class is up to the sixtieth percentile of working children. As nearly as could be estimated from data at hand, this average is about the median for school children.

As regards mental standing the results are quite different. The average of the mental tests shows the class to be slightly below the average of working children. In the cancellation of *a*'s, while

<sup>2</sup> The norms for fourteen- and fifteen-year-old working children can be found in "A New Scale of Mental and Physical Measurements for Adolescence, and Some of Its Uses," by Helen Thompson Woolley, in the *Journal of Educational Psychology*, November 1915. The norms for sixteen-year-old working children and for fourteen- and fifteen-year-old school children have not been published, but were obtained through the courtesy of Dr. Woolley.

PSYCHOGRAPH I. GROUP

BASED UPON THE AVERAGE OF THE PERCENTILES FOR EACH TEST



very accurate, they were so slow that the index, which is found by dividing the time by the accuracy, is low. The accuracy seems to have been gained at the expense of speed. Immediate memory, found to correlate highly with school standing, is low. This agrees well with the fact that the boys did not get along well in school and were retarded. The substitution test is very significant. The first page is much below the median, the second page is above, the third page is still higher, and the last page is above, but not so high as the third page. The first page indicates a slow adjustment to a new situation. The indices of pages two and three indicate that great gain can be made through practice. But the practice is not well retained, as is shown in the drop on the third page. On the whole, the test shows a medium amount of ability to learn a routine piece of work. In the sentence test, the class was below the median in the number of sentences begun in two seconds, indicating slow association. The total number of ideas was high, but this is of doubtful significance, as the results for feeble-minded children may give a large number of ideas; but the idea index, found by dividing the time by the number of ideas, shows again that the class is very slow. The number of sentences correctly completed reflects the school training. This agrees with the record of the boys in school.

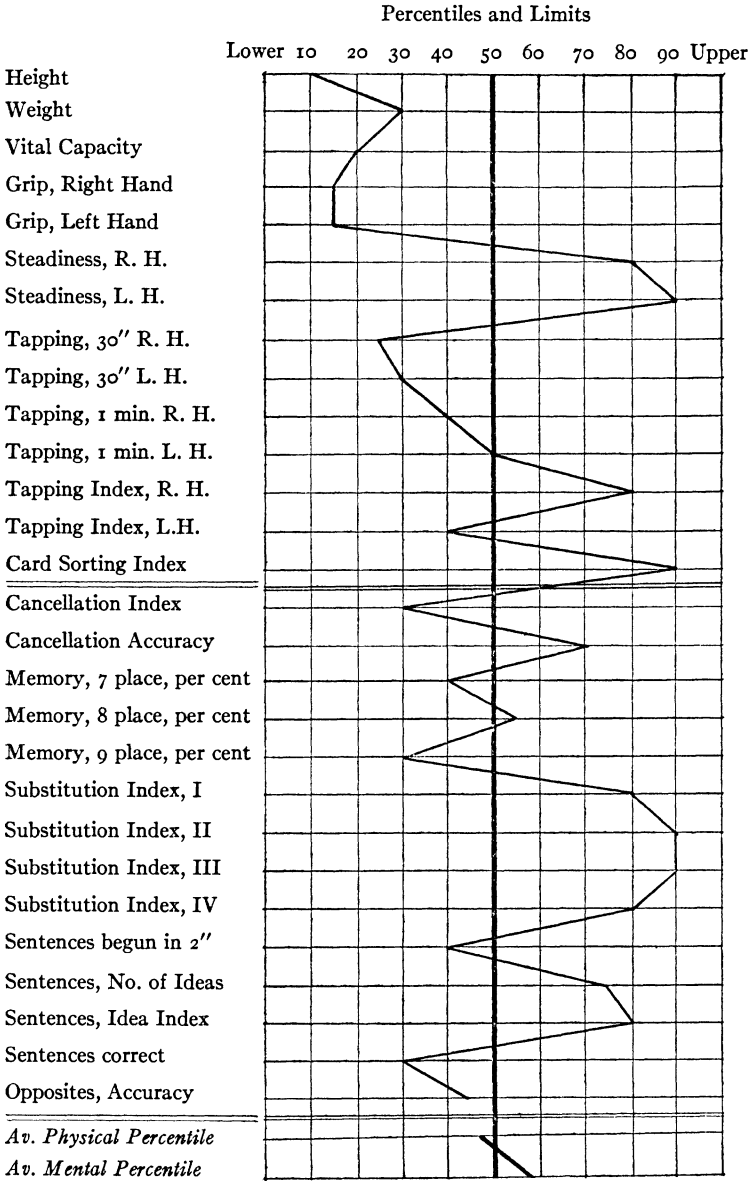
Were we to compare this group with school children, we should find them much below the latter mentally.

Psychographs II and III represent two different types of boys. In general, the boys of this group are represented by C. M. in Psychograph III, who is superior physically and inferior mentally, but there are some, like G. D. in Psychograph II, who are better mentally than physically. In this group, 7 are of the type of C. M., 2 are of the type of G. D., 4 are above the median both physically and mentally, and 3 are below the median both physically and mentally. The presence in the class of the 4 boys whose rank is above the median needs further explanation: one has an uncontrollable temper and very little will power; one is sickly; another is absent from school a great deal of the time; and the other has been in the class so short a time that he is not well known.



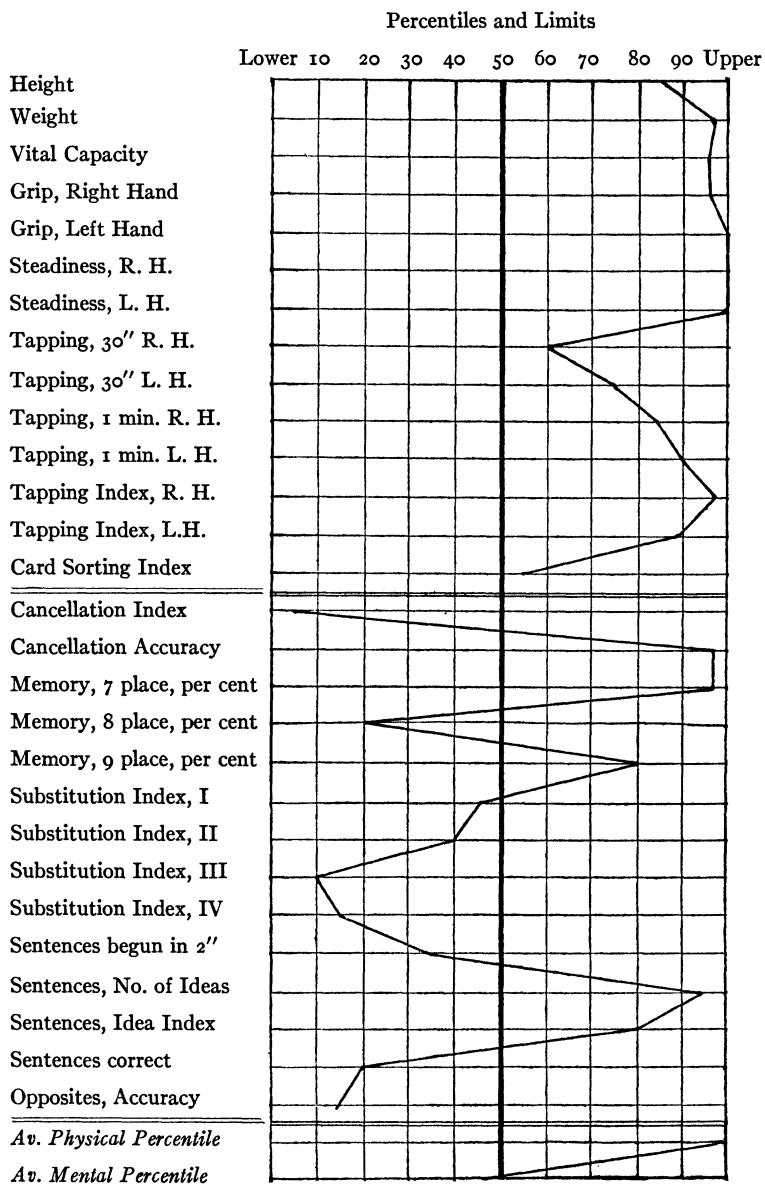
PSYCHOGRAPH II.—G. D.

A CASE HIGH MENTALLY AND LOW PHYSICALLY



## PSYCHOGRAPH III.—C. M.

A SUBJECT WHO IS LOW MENTALLY AND HIGH PHYSICALLY



Concerning the prospects of the types just mentioned, Dr. Woolley makes the following comment:

The individuals who stand consistently low in both respects seem destined to simple manual labor, or low grade industrial positions, provided they have the necessary physical strength. Those who are very lacking in mere strength as well, have slim prospects of being able to earn a living in the modern world. The group whose mental endowment is rather poor, or medium, but whose manual ability is good, should be prepared for the skilled trades. Those who have a medium endowment of both kinds should be guided toward the great mass of secondary positions in business and industry. Those whose mental development is exceptionally good, but who are lacking in manual skill, should be directed toward such professions as law, the ministry, literary pursuits, the non-experimental academic branches, the higher positions in business and finance, and some types of social work. Those who are gifted with exceptional ability in both directions, manual and mental, should be guided to such professions as medicine, architecture, engineering, the experimental sciences, the arts, and certain types of social work.<sup>3</sup>

The kind of work which these boys are best able to do is physical. The kind of education they should have is that which will prepare them for the skilled trades. They are not likely to go into the higher schools, so it is best that what schooling they have should be of immediate, practical value. Such training is the aim of prevocational education.

#### CORRELATIONS

In dealing with so few cases it is difficult to find a method which gives reliable results of correlation. A number of methods were tried, but finally the Spearman method was used, but checked by plotting and by the Pearson method. Judged by the plotting, the correlation in all cases would have been considerably higher if one or two extreme cases could have been eliminated. All Spearman coefficients have been converted into Pearson values by the formula

$$r = \sin \left[ \frac{\pi}{2} R \right].$$

The rankings for the mental and physical tests were obtained from Tables I and II. For the school work, the teachers were

<sup>3</sup> "A New Scale of Mental and Physical Measurements for Adolescents and Some of Its Uses," *Journal of Educational Psychology*, November, 1915.

asked to rank the pupils. The ranking for the shopwork was kept by itself, but the rankings for the arithmetic, the English, the history, and the science were combined into a single set of rankings by adding the ranks of the various teachers and dividing by the number of ranks so added. Lack of acquaintance with some of the boys made a ranking impossible for one of the teachers. Table III shows the ranks assigned by the different teachers, and the final, or composite, rank.

The most striking correlations were between mental tests and school work and between physical tests and shopwork. The correlation of the former, translated into terms of the Pearson coefficient, is 0.38, the latter is 0.43. There was no correlation

TABLE III  
RANKING IN SCHOOL WORK

Pupil	Science	Arithmetic	English	History	Total	Average	Final Rank	Shop
J. D.....	2	5	3	1	11	$2\frac{3}{4}$	1	4
G. D.....	1	3	10	5	19	$4\frac{3}{4}$	3	5
F. R.....	3	2	7	7	19	$4\frac{3}{4}$	3	9
F. S.....	5	1	4	9	19	$4\frac{3}{4}$	3	12
H. R.....	10	6	1	4	21	$5\frac{1}{4}$	5	1
A. T.....	6	9	6	3	24	6	6	2
R. W....	4	7	13	2	26	$6\frac{1}{2}$	7	3
R. T.....	7	4	12	6	29	$7\frac{1}{4}$	8	8
R. B.....	11	.....	2	11	24	8	9	11
E. R.....	8	.....	9	8	25	$8\frac{1}{3}$	10	15
D. S.....	12	8	8	12	40	10	11	6
C. M.....	9	11	14	10	44	11	12	7
S. M.....	15	12	5	14	46	$11\frac{1}{2}$	13	13
T. L.....	13	10	15	13	51	$12\frac{3}{4}$	14	14
J. Mc....	14	.....	11	15	40	$13\frac{1}{3}$	15	10

between mental tests and shopwork and none between physical tests and school work. School work correlated more highly with page four of the substitution test than with any other mental measure, having a correlation of 0.47. Shopwork correlated well with the tapping index, 0.35, and with the number of taps in one minute, 0.38, but was most highly correlated with the strength of grip, 0.54.

#### SUMMARY AND CONCLUSION

These tests show that these boys are:

1. Physically superior and mentally equal to working children.

2. Physically equal and mentally inferior to school children.
3. Able to learn routine work well.
4. Slow but accurate.
5. The material out of which skilled tradesmen and mechanics can be made.
6. In need of the kind of instruction offered through pre-vocational education.